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Interactive comment on "What determines the sign of the evapotranspiration response to afforestation in the European summer?" *by* Marcus Breil et al.

Anonymous Referee #1

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What determines the sign of the evapotranspiration response to afforestation in the European summer? Marcus Breil, Edouard L. Davin and Diana Rechid

BioGeoScience (2020 – 275) paper:

The paper deals with the afforestation effect on evapotranspiration rate (ET) of the European continent. The paper uses a Regional Climate Model COSMO-CLM to compare ET changes due to a scenarios of afforestation of the whole European landscape vs. the ET rate of a fully grassy European landscape. Five different variables, that are dependent on three land cove types (two forests types and grassland) are used in the model to deduce the ET rate per unit area for the continent. The model finds that

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what mainly governs the ET rate in the summer time is the water saturation difference between the ecosystem surface and the above air. In southern Europe, where solar radiation burden is high, grassland ecosystem ET is higher than forest ET because the grassland surface temperature is higher than that of the forest ecosystems, thus the water deficit there is higher. In northern Europe, forests ET is higher and this due to higher absorb radiation by the forest ecosystem, while a small surface temperature difference exists between the different ecosystem types. It is an interesting, conceptual paper that tries to help resolving an ongoing question of the effect of land cover change on ecosystems ET rate, in particularly by the change from a grassland to a forest ecosystem across a wide climatic conditions. As such the paper is within the scope of the journal and of high interest for wide disciplinary communities. However, I find two major weak points in the paper that require serious revisions: 1. Model results vs. ground base measurements results. As the authors rightly wrote, based mainly on runoff measurements, forest ecosystems ET are mostly higher than grass ecosystems ET and the differences are functions of many variables, partially presented by the authors. Based on what I am familiar with, in most (if not all) Mediterranean dryer parts, summer ET in forest is higher than that of any paired grasslands sites. See, for example, papers on California (Ryu, et al., 2008, and Baldocchi et al., 2009) and for the Eastern Mediterranean region (Rohatyn, 2018), which seem not to agree with the paper main results. An important part of the explanation for the lower ET in grassland ecosystems in summer in such regions, is that the grassland is mainly annuals, which are dying toward the summer while the trees keep evaporating all year long. This is likely the adaptation of annuals grassland plant types to the regional dry climatic conditions. In wetter regions, the ET difference, based on FluxNet data, are less pronounced, and the paper is in agreement with studies that show that the ET differences depends on local conditions. This leads to the next comments.

2. Comment for the conceptual aspects. a. As the Authors rightly mention, vegetative ecosystem is much more complicated than described by the 5 parameters present in Table 1. However, it seems, there are several important mechanisms that could

override the dominant effect of the increase in water saturation deficit presented by the paper. Ranking the importance of the different mechanisms, function of the local climatic conditions, on plants types, its ages, its density, soil conditions, are avoided. Among those important factors, there is insufficient consideration in the paper of factors such as: the phenology effects (e.g., the annuals life span; see above), the structural effects on the transpiration rate (trees are multi–layers, which has an effect on the leaf to air temperature difference and VPD within the canopy, on light intensity, and more), the understory contribution to the ecosystem ET, etc. Obviously, the model cannot include all of these effects, but should at least be discussed, with respect to the difference between the model finding and measurements results, and to provide possible explanations, and possibly how to better simulate these additional factors. b. Feedbacks between the vegetation and the atmosphere. It should be possible for a paper, where the results are based on a regional climatic model (COSMO), to discuss some vegetation-atmosphere feedbacks. For example, it is shown that the sensible heat flux is higher at the southern parts of the continent, this should dry the air and raises its temperature and may increase the leaf to air VPD for the forest model runs. Or, what is the effect of the higher ET (by the grass) on cloudiness and Rn? Referring to such effects could be of a valuable to such model-based paper.

Minor comments: 1. Since the effect of higher ET by forest is a puzzle for most readers and the explanation is through the higher surface temperature of the grass ecosystem, it is suggested to move this text to an earlier part of the results section, including Fig.' 5 b & e. Does the model calculate the leaves' skin temperature, and if so, how? 2. The paragraph, starting in line. 163 is unclear. 3. Line 182. It is likely that soil ET rate is affected by soil layers deeper than 5 cm. This sentence is questionable. And for line 187 - the soil contribution to ET could be very important (up to several ten percent of total ET). 4. Figure 3, units for the soil humidity values are unclear. Also note that part 'c' is noted twice in the caption (instead of 'd'). 5. Figure 4 units are unclear. 6. To better understand the different effecting parameters on ra and rc between the ecosystems types it is suggesting to add Wwilt and Wroot values to table 2.

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Papers: Rohatyn, S., et al. (2018). "Differential Impacts of Land Use and Precipitation on "Ecosystem Water Yield"." Water resources research 54(8): 5457-5470.

Baldocchi Dennis, Qi Chen, Xingyuan Chen, Siyan Ma, Gretchen Miller, Youngryel Ryu, Jingfeng Xiao, Rebecca Wenk and John Battles (2009). "The Dynamics of Energy, Water and Carbon Fluxes in a Blue Oak (Quercus douglasii) Savanna in California, USA", in: "Ecosystem Function in Global Savannas: Measurement and Modeling at Landscape to Global Scales" – edited by Michael J. Hill and Niall P. Hanan, CRC/Taylor and Francis.

Ryu Youngryel, Dennis D. Baldocchi, Siyan Ma and Ted Heh (2008), "Interannual variability of evapotranspiration and energy exchange over an annual grassland in California", JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 113.

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